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MOBILE APPLICATION OF OPEN SOURCE STACK TO GEO-BASED DATA VISUALIZATION ON E-GOVERNMENT WEB FRAMEWORK

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ABSTRACT

Mobile web technologies by diverse open sources are expanding and developing so fast. Furthermore, open data policy of public organizations and governments in many countries prevails. In Korea, e-government standard framework has been developed based on Spring Framework and distributed to improve implementation efficiency of web-based information systems for public domains. For wide applications and adoption of this webframework, e-government standard framework for mobile environment was also released. These trends evoke new type of geo-based applications, and practical cases are being implemented. This open source project is for data visualization on mobile, which reflects these aspects. For implementation, open source stack including GeoServer, jQuery, OpenLayers and D3.js was applied, and e-government mobile standards framework was used for mobile UX/UI components, as well as HTML5. It is expected that this approach provides practical reference and technological basis to develop target-oriented mobile application business models using open data and e-government mobile web framework.

1. INTRODUCTION

Popularity of mobile devices evokes mobile web service. W3C(World Wide Web Consortium) developed and released several standardization technologies for mobile web implementation such as graphics and layout, device adaptation, forms, or data storage (W3C, 2015). While, open data policies of country administration, local government or public organization are globally the significant another global trend. In Korea, Government 3.0 policy is for government operation to deliver customized public services by opening and sharing data which were produced or owned by government, to make service-oriented, competent, and transparent ones. As of July 2015, approximately 13,000 open data from about 790 sites are available in the form of web-accessible open API or downloadable data sets (<http://data.go.kr>). Seoul metropolitan city also provides open data policy in the Seoul open data plaza (<http://data.seoul.go.kr>). Among them, lots of geo-based data are also included. Kwakkelet *al.*(2014) emphasized on spatial data visualization and its value linked with regional characteristics. However, spatial data is more complicated data structure than text or image data sets, and general users with less experiences or understandings regarding geo-based data structure and main features with it might have some difficulties to utilize their applications in any fields.

From 2009 in Korea, there is an important open source policy of web application framework named the e-government, original notation of eGovernment, standard

framework which covers an infrastructure environment for implementing application software, supporting basic functions in the application runtime. It is toward increase the quality of government-based public services, the efficiency of IT investing cost and the standardized reusability of application.

Geo-spatial web running on desktop web browser is moving to mobile web environment. Mobile web needs user experience and interface, different from desktop web. Moreover, uses of easily accessible open data greatly expands owing to the mobile portability. Also open data is good for web-based application based on open source. Components for mobile web implementation of the e-government standard framework are regarded as the practical needs from business side for enterprise geo-spatial web. This work is to develop an application model of the e-government standard framework for geo-based mobile web with open data visualization, based on full open source stack including GeoServer, PostgreSQL/PostGIS, OpenLayers and D3(Data-driven Document).

2. E-GOVERNMENT WEB FRAMEWORK IN KOREA

The main features with the e-government standard framework, Apache license version 2.0, in Korea can be summarized: compliance with open standards on the national scale, integration with commercial solutions, flexibility to cope with the newest technologies, and easiness to use and function-rich environments. It minimizes redundant developments by providing common essential functions and allows developers to concentrate on the business logic by defining an infrastructure, and increases the standardization of the development framework allows components already developed on this framework to be reused in other application systems, and the interoperability of application systems by using standard inter-system integration interface. This framework, composed of the runtime environment with the multi-layer such as the screen processing, the business logic processing, the data processing, the integration processing and the common foundation, the development environment, the management environment, the operation environment and the common components which is a collection of reusable application programs to be used in the application software development of many on-going e-government projects.

The runtime version of this standard framework is 3.1 as of July 2015, based on Spring Framework 3.2.9. For mobile web service and hybrid app development, the additional version of this standard framework was released in 2011. Mobile version 2.7 under MIT license is composed of mobile runtime environment and mobile common component. The former uses jQuery and jQuery mobile for dynamic manipulating of HTML document and JavaScript. Kim and Lee (2015) developed a mobile application using this mobile runtime environment to present simultaneous visualization functionality for public data and geo-based data. The eGovFrame portal (<http://www.egovframe.go.kr>) is to present lots of information for both public uses and business promotion of the e-government standard framework. The National Information Society Agency, one of government-supported agencies for information technology promotion, has carried out administrative tasks for official certification for interoperability and compatibility confirmation service of this standard framework. Currently, about 45 software products have passed this certification test in the field of DBMS, WAS, portal solution, CMS solution, UX solution, and security solution. But no geo-based solution have yet been received this certification.

3. GEO-BASED VISUALIZATION BASED ON OPEN SOURCE

Open source stack has been utilized to build the visualization technology of geo-spatial

information derived from open data on the mobile web. Tomcat was used for the web server and the container. Web frameworks were utilized in the e-government standards based on the Spring Framework. In particular, lots of open source for geo-spatial information were applied. GeoServer and PostgreSQL/PostGIS have been used to store and manage geo-spatial information. In the integrated system, GeoServer was used to easily publish web-recognizable standards as WMS (Web Map Service) and WFS (Web Feature Service) with files or databases in PostgreSQL/PostGIS, a relational database management system to store and edit spatial information. As an integrated system based on these open source environments, OpenGDS MAS (Mobile Application Server) was implemented in this work.

Mobile runtime environment in the e-government standard framework was applied for an optimized configuration for UX (User Experience)/UI (User Interface) in the client panel for a mobile web. Mobile runtime environment consists of jQuery and jQuery Mobile, and additional eGov mobile is extending the jQuery Mobile library. For the web mapping, OpenLayers 3 supporting mobile web were used. For on-line visualization of open data, D3.js which is JavaScript library set generating interactive charts and graphs was utilized. It uses SVG (Scalable Vector Graphics) of HTML5.

As the integrated open source project linked with D3.js and OpenLayers, OpenGDS MCL (Mobile Client Library) was implemented in this work. Table 1 summarizes open sources and the development environments used in this study.

Table 1. Open source environment of geo-based data visualization

| | Environment | Name / Version |
|--------------------|--|---|
| Application Server | Web Server / Container | Tomcat / 7.0.56 |
| | Web Framework | E-GovFramework / 3.1 - Spring Framework / 3.2.9 |
| | Geo-based Data Server | GeoServer / 2.6.0 |
| | Geo-based Database | PostgreSQL / 9.3 PostGIS / 2.1 (Extension) |
| | Geo-based&Public Data Management / Request | OpenGDS Mobile Application Server / 1.0 |
| Mobile Web Client | Mobile UX/UI | E-GovFramework Mobile UX, UI / 2.7 - jQuery / 1.9.1 - jQuery Mobile / 1.3.2 - eGovMobile / 1.3.2 |
| | Geo-based Data Visualization | OpenLayers / 3.5 |
| | Data Visualization | D3.js / 3.5.1 |
| | Coordinate Translate | Proj4js / 2.2.2 |
| | Integrated Visualization | OpenGDS Mobile Client Library/ 1.3 (using jQuery Mobile, OpenLayers, D3.js) |

The architecture of the application system running on the e-government standard framework is shown in Figure 1. Application server is composed of data access, service, and controller object. According to the request of the mobile client, the controller is charging the responses for data visualizing and processing. Attribute request function is to retrieve the table, connecting to PostgreSQL. In this time, Mybatis in conjunction with the Spring Framework was used for SQL mapping framework to manage requesting database in Java.

Open data is mainly used in the form of open API capable of functioning real-time data requests and responses from public data portal in Korea government or open data portal in Seoul metropolitan city.

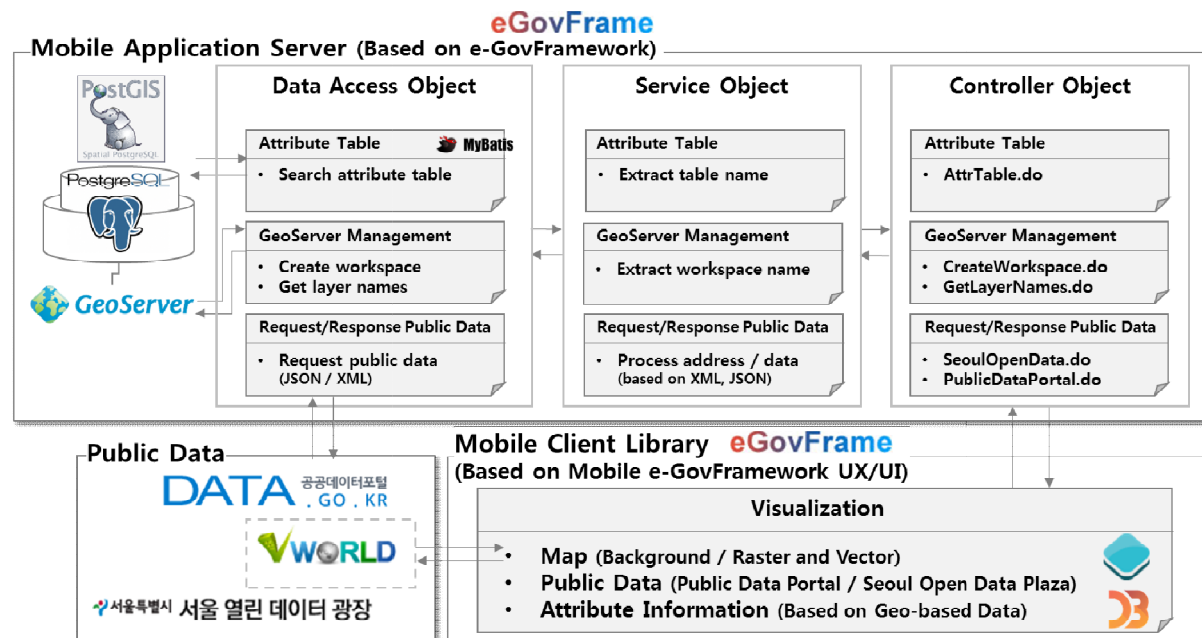


Figure 1. An architecture of mobile visualization web for geo-based data and open data.

4. MOBILE WEB APPLICATION IMPLEMENTATION

Mobile web applications for managing and visualizing of multi-typed open data and geo-based data was implemented using OpenGDS MAS and MCL. Geo-based open data in this work were stored and managed in PostgreSQL, and integrated visualization was carried out by using GeoServer and OpenLayers 3 on mobile web browser.

Figure 2 shows the result of visualization of multi-typed geo-based data. The Seoul district boundary of the polygon type was provided by the Ministry of Land, Infrastructure, and Transport in Korea. Point type data for air quality measurement was collected by downloading from the Seoul open data plaza. This mobile web application provides client functions such as transparency controlling of overlaid layers and layer visibility, listing, ordering, and deletion.

Figure 3 shows the results of attribute visualization in table. Figure 3(a) and (b) are visualization of the spatial properties in Seoul and Busan, respectively. Figure 4 is a public open data visualization results by open API, not downloading open data. Figure 4 (a) is on-line mapping for area characterization. Other Figure 4 (b) shows bar chart by data visualization library of D3.js.

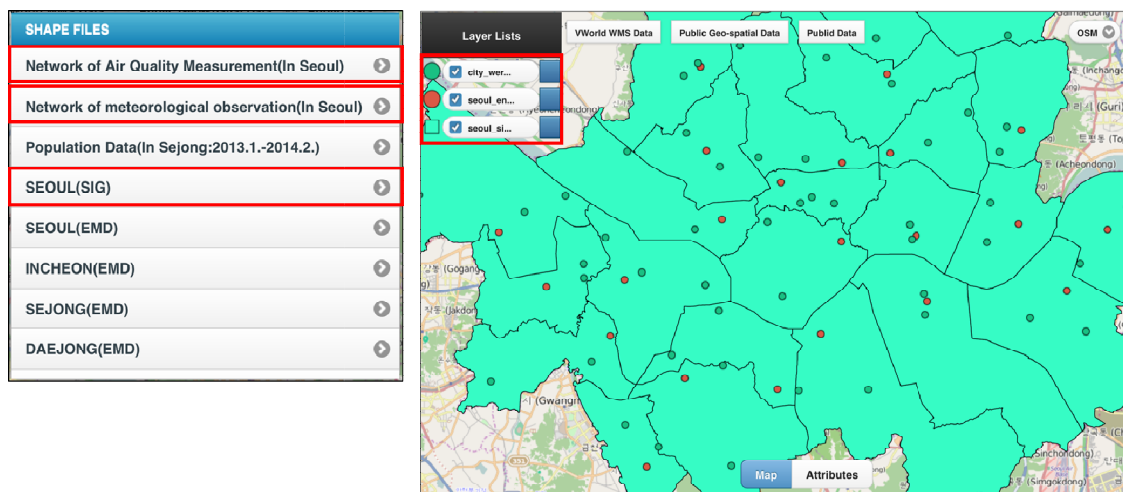


Figure 2. Visualization of multiple typed geo-based data using mobile UX/UI on the e-government web framework.

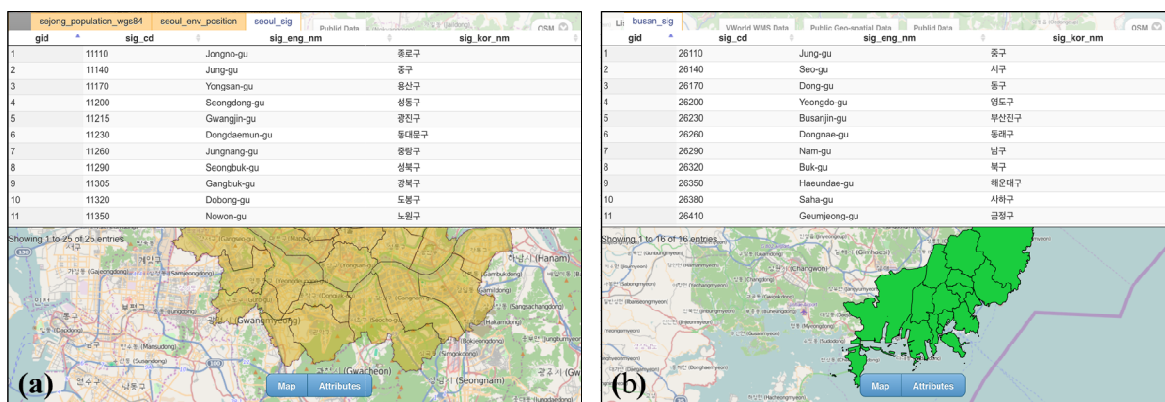


Figure 3. Attribute visualization of public geo-based data: (a) Seoul and (b) Busan.

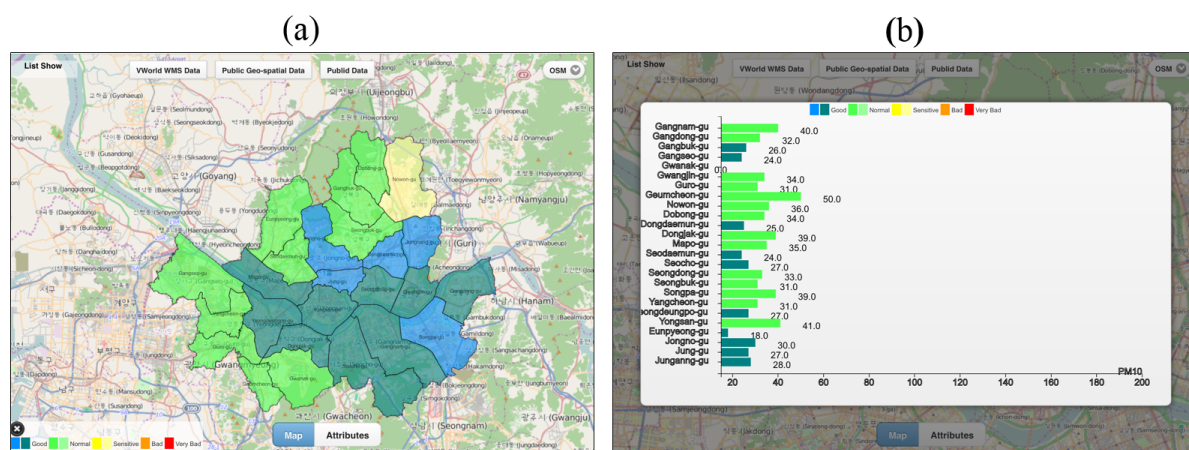


Figure 4. Visualization results using open API on the e-government web framework: (a) on-line mapping and (b) bar chart.

5. CONCLUDING REMARKS

Open source stack was developed for open data application. This project focuses on mobile web visualization of geo-based data and other typed open data. While, the e-government web framework and the mobile extension are also applied as important implementation specifications. For the actual application implementation, geo-spatially specific open sources such as GeoServer and OpenLayers and mobile visualization open sources such as jQuery and D3.js were used. The e-government mobile standards framework was used for mobile UX/UI components. It is expected that this approach provides practical reference and technological basis to develop target-oriented mobile application business models using open data and the e-government mobile web framework.

6. ACKNOWLEDGMENTS

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